N.A.C.A. BULLETIN

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MAY 15, 1949

A RATIONALE OF INCOME DETERMINATION—THE CURRENT COST OF PRODUCTIVE EQUIVALENTS CONCEPT

by EDWARD L. WALLACE,
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The author of this paper accepts the postulate that historical costs are inadequate as income determinants because they do not give effect to changes in the value of the dollar since they were incurred and concurs with those who would adjust costs for income determination through the use of price indices. However, he suggests use of specific price indices rather than an index of general purchasing power and proposes further that effect be given to technological developments by recognizing as current cost the current productive equivalents of expired cost elements.

THE inadequacy of the recorded dollar costs of expired assets as a measure of the economic costs of revenue production becomes a dominant one in periods of extreme economic expansion or contraction; but it exists and surreptitiously decreases the utility of income determinations even in times of relatively stable economic conditions. It is a situation which has existed and will continue to exist so long as accountants, through necessity or choice, measure the result of the efforts of the business entity by matching periodic revenues produced through operations with the recorded dollar costs of those assets of the entity which have expired in the production of such revenues.

Inadequacies in Income Measurement

Managements of industrial enterprises have been placed by accountants in the incongruous position of being forced to report in annual statements to stockholders and the general public a figure represented to be as accurate as possible a measure of the annual income of the enterprise, while, at the same time, by supplementary comments, they endeavor to prove to the reader that this reported figure bears, in many cases, little or no similarity to the enterprise income it supposedly measures. The reporting of enterprise money income by the accountant has played no small part in stimulating the wage demands of labor groups, extra dividend demands by investors, and the allegations by various members of governmental bodies that corporate incomes should be taxed more heavily.

In the heat of the situation created by reports of enterprise income based upon present accepted accounting standards, accountants have reacted today just as they have under similar circumstances in the past. The majority, for diverse reasons, have counseled adherence to present accepted accounting standards, preferring the continuance of a method of income determination which utilizes to the greatest extent possible the objective evidence of recorded dollar costs, even though such a measure of income may neither approximate nor be capable of conversion into a measure that meets the needs of those who are to use these statements. A few, aware of their responsibilities, have endeavored to find new methods of recording costs or utilizing index numbers for cost conversions that will determine a measure of income which meets the needs of management, the investor, and the general public.

Need for Agreement on Concept of Income

Many of the suggestions propounded by the latter group possess considerable merit. Unfortunately, these suggestions for the most part have, heretofore, been of limited scope and have never been developed beyond their original stage. It is to be feared that, as in the past, the elapse of time will diminish the urgency of the situation and the meritorious beginnings of a concerted effort toward the solution of the problem will be swept aside.

If we are ever to realize progress to the procedural stage in the development of new accounting standards that will rectify the shortcomings of those in use at the present time, the first step must be a clear designation of the concept of income desired, a model of a statement which would determine such income, and an outline of the theoretical methods of determination of the costs and revenues to be presented thereupon. It is the goal of this paper to make progress toward such an end.

Basic Assumptions of Accounting

Accounting has as its basic purpose the recording, analysis, and presentation of financial data concerning a business enterprise in such a manner as to meet the needs of management, investors, and the general public. As practiced at present, it is founded upon several basic premises which are in and of themselves assumptions of varying degrees of validity.

The business entity is assumed to be an institution separate and distinct from all associated groups. In most instances, this assump-

tion is founded upon managerial or legal fact. Its continuance under any new scheme of accounting is felt to be justified on the basis of the utility of the clear separation of the activities of the business entity from the activities of related groups. Indefinite continuance of operations of the institution is likewise presumed. This concept of the going concern is in keeping with the normal situation to be found in our economic society. Liquidation is the exception rather than the rule. No assumption beyond mere continuance of the operations of the enterprise is made. Contraction or expansion of operations comes only as the result of managerial decisions. Ordinarily the fiscal year is, and should be retained as the ordinary period of measurement of enterprise income.

It is the assumption that cost and revenue are measured by cash or its equivalent exchanged at the time the transaction takes place, together with the attendant assumption that a dollar of measure at any time is the equivalent of a dollar of measure at any past or future time, that must be modified in keeping with a revised concept of income. Income, for reasons to follow, will be defined as the excess of revenue over associated costs, as those costs are defined under the new scheme.

As a result of the use of present accounting standards predicated upon the unmodified assumptions previously outlined, accountants have measured present enterprise income solely in terms of the excess of dollars or their equivalent provided through the revenue stream over the historical cost dollars of the goods and services embodied in or associated with the product sold. If the revenue stream does not prove adequate to exceed the associated costs, a loss is reported. This concept of income or loss is simply a monetary measurement under which all dollars are assumed to be homogeneous.

Of course the mere fact that present accounting standards develop an income figure that is solely a dollar measure of this concept is not sufficient grounds for the rejection of this method of measurement. The basic test of the validity of this or any other method of measurement of income is whether or not the income figure, as exhibited, does in effect meet, to the highest degree attainable, the needs of those groups interested in the enterprise and for whom the accountant practices his art. In this respect it should be noted that the fact that a method of income determination is inapplicable at the present time, because procedures have not

been developed allowing its usage, is simply an argument for the development and refinement of such procedures.

Needs of the Investor

A business enterprise capable of carrying on productive operations cannot spring from a vacuum. Originally there must exist an individual or individuals who possess, for the most part, funds representing general claims on goods and services (i.e. general purchasing power). The decision by a group of such individuals to commit all or a portion of such funds to the control of a second group of individuals is predicated upon the decision by each individual investor that, considering the attendant risks, this particular disposition of his savings will maximize future income from these savings. The stream of future personal income that each investor envisions at the time of investment is measured by him in terms of dollars having the same general purchasing power as those that he invests.

However, the investor as a member of a group of individuals has committed his funds to the control of a second group, the management of the existent or projected enterprise, because it is his belief that under the administration of the second group he will accomplish his principal aim. This determination and resultant decision by the investor group as a whole has been based upon an implicit or explicit agreement between them and the management that such funds will be utilized for the purpose of procuring goods and services of such specific types as are required in the planned production and distribution of the salable end product of the enterprise. It is by means of this *particular* activity, the planned production and distribution of a *specific* end product, that the investor group anticipates that it will maximize its future personal income. For this reason and as will be pointed out later the individual investor is best served by that concept of income which most effectively measures the degree to which management has discharged its trust. This involves the matching of revenue with costs measured in terms of current dollars of specific rather than general purchasing power.

Needs of Management

The transferred funds which, in the hands of the investor, originally represented general purchasing power, once entrusted

to the management for a specific purpose become, in effect, funds possessing, in so far as the management is concerned, solely specific purchasing power measured in terms of current prices of the goods and services needed to conduct the planned operations of the enterprise. It is the responsibility of the management to invest these funds in those particular types of goods and services. As these specific goods and services are converted into units of saleable product, it is the further responsibility of such management to secure in exchange for the product an aggregate of dollars possessing, at the moment of exchange, *specific* purchasing power equal to that originally entrusted to it and invested in the goods and services embodied in or associated with the product sold, *plus* an additional amount of dollars sufficient in *general* purchasing power to meet the income expectations of the investor group as a whole. For this reason, management has need of a system of accounting that will measure in the above terms the degree to which it has discharged its responsibilities to the investor.

For management purposes, then, the costs to be associated with revenue should be expressed in dollars having specific purchasing power at the time of sale equal to that possessed by the original funds invested in the goods and services embodied in or associated with the product sold. The sole measure of such a cost would be the market price of an equal amount of such goods or services *or their productive equivalents* at the time of the sale. Such a measure of cost will hereafter be designated as the current cost of such goods and services.

To the investor group this measure of enterprise income should partially fulfill its needs. The current costs associated with revenue are to the investor representative of the original funds entrusted to the management, and they must be maintained and judiciously reinvested by management in additional goods and services if operations are to continue and anticipated future income secured. The residual cash or its equivalent as measured by the excess of revenue over current costs is a measure of enterprise income that partially fulfills the needs of the investor group.

These current dollars of reported enterprise income must be adjusted by the investor himself, through the use of an index of general purchasing power in order to secure for his needs a measure of personal income in dollars having the same purchasing power as those of his original investment. In this way the resulting enterprise income figure *after such adjustment* may

be compared to his standard of anticipated personal income and the accomplishment determined. As an individual, the investor is capable of divesting himself of his investment, securing in return dollars of general purchasing power reflecting those reported in the initial enterprise income figure. With these dollars, if he so desires, he can make an alternative investment.

The aims, then, of the investor are embodied in the concept of the maintenance by the enterprise of its specific purchasing power and the maximization of its income, which to him is the excess of revenue over costs measured in terms of dollars of specific purchasing power (i.e. current costs). This aim is the same for management and it is the responsibility entrusted to management for which it is accountable to the stockholders.

The General Public

Does a measurement of income in the above manner meet the needs of the general public? An answer in the affirmative would seem to be warranted. Current cost measurements emphasize the importance of an aggregate of physical capital rather than an aggregate of dollars. The public as a whole should be aware of the paramount importance of aggregates of physical capital and the increases and decreases in such aggregates occasioned by economic activities. It is only by increases in aggregates of physical capital and their resultant productivity that the general standard of living of the society as a whole can be raised.

Historical Costs Do Not Measure Up

By definition, recorded dollar costs, as now employed under present accepted accounting standards, are not a measure of current costs. It follows, then, that enterprise income as now measured through the use of recorded dollar costs is not the measure of enterprise income required to meet the needs of these three associated groups. It is true that if, in the long run, economic conditions should remain stable and, as will be discussed below, technological development stagnates, then recorded dollar costs would for the most part approximate the required current costs. The important consideration is that such conditions have never and in all probability will never exist. Therefore, the continuing use by accountants of recorded dollar costs in the determination of enterprise income is in direct contradiction to the purpose of accounting. What is required now is a modification of present

accepted accounting standards and the development of attendant procedures which will permit the accountant to determine enterprise income by the use of current costs.

Use of Specific Price Indices Contemplated

There is in existence at the present time a system of accounting which expresses recorded dollar costs in terms of current dollars. Presented in 1936, it is embodied in a volume entitled "Stabilized Accountant" by H. W. Sweeney, published in that year. This system, termed stabilized or common dollar accounting, uses for its principal tool of cost measurement, an index of general purchasing power applied to recorded dollar costs in order to express them in terms of dollars of general purchasing power equivalent to those measured by the revenue figure. The measuring of enterprise income in this manner implies that both management and the investor group are interested in securing through revenue producing transactions, an aggregate of dollars sufficient to equal the general purchasing power of the dollars invested in the specific types of productive goods and services, embodied in or associated with the product sold.

This emphasis upon the maintenance of general purchasing power ignores the aims of the investor group and management. As has been pointed out in discussion of the aims of both groups, the investor group is interested in the maintenance of a stream of future enterprise income as well as its present procurement. This anticipated stream of future income from the enterprise is predicated upon the assumption by the investor that the enterprise will continue to produce and sell specific products. If the continuity of such operations is to be provided for and the future income anticipated by the investor secured, it is necessary that the *specific* purchasing power of the enterprise with respect to the actual productive goods and services needed to continue planned operations, be maintained. Present income of the enterprise, in so far as the investor is concerned, can be measured only after the specific purchasing power needed for planned future operations has been secured from the revenue stream. The maintenance of this specific purchasing power is part of the responsibility of management for which it is accountable to the investor group.

It is upon this basis that the validity of the stabilized accounting or common dollar approach is denied. The degree to which the management has been successful in maintaining, through opera-

tions, the specific purchasing power of the enterprise, can only be measured by the use of a series of specific price indices, each limited to a measurement of the changes in price of one specific good or service, rather than a single general index. It should be obvious that, at best, the results obtainable through the substitution of a weighted general index of prices would be only a rough approximation of the required measure and, in many instances, because of the substantial variations normally found between the prices of specific goods and services and the general level of prices, a serious error in income determination might very well result from the use of this index.

The general price index has utility for the individual investor. As previously discussed, once enterprise income has been determined by the use of specific price indices for the purpose of measuring cost (i.e. current costs) the individual investor should convert these current dollars of enterprise income to dollars of the same general purchasing power as those he originally invested in the enterprise.

Administration of Income Not Involved

It is unfortunate that in the past, the current cost approach to the problem of income determination has been described as an endeavor by the accountant to measure costs to be associated with revenue, in terms of the replacement prices of the specific goods and services the costs of which are being measured. This explanation in itself is not in error but inadequate further explanation of the statement has lead to the belief by some accountants that what is in effect being estimated here is the future price of replacing the specific good or service at the time when management decides that physical replacement is warranted. This mistaken idea has given rise to condemnation of the approach by certain writers on the grounds that the accountant, under such a system of accounting, is assuming the function of income administration rather than contenting himself with the problem of income determination.

This particular criticism of the current cost approach is unjustified. Under the method of income determination utilizing current costs, it remains the prerogative of management to decide the time and the manner in which existing and expired productive facilities will be replaced. The accountant is merely measuring the costs to be associated with revenue in terms of the specific

purchasing power invested in the goods and services expiring in the production of such revenue. The function of measurement of such specific purchasing power, by reference to the price upon the market *at the time of sale* of an amount of specific goods and services equal to those embodied in or associated with the product sold, has nothing to do with the process of physical replacement of such items. Even if we should assume the infinite divisibility of the factors of production so that management could, if it so desired, procure at the time of sale an amount of specific goods and services equivalent to those sold, there is nothing in the current cost approach that would necessitate such replacement. Physical replacement can only be accomplished by management's decision to do so.

In line with the above discussion, attention should be drawn to the fact that measurement of the cost of such items as depreciation will not provide funds for future replacement. This is true whether we employ the historical or current cost approach. The provision for the availability of sufficient funds at the time required is part of the administrative duty of management, and is in no way related to the income determination function of the accountant.

Current Cost Includes Concept of Cost of Productive Equivalents

The procedure for the determination of periodic income under the current cost approach differs from such determinations made under the historical cost method only in the manner in which the costs to be associated with revenue are measured. Enterprise income is defined as the excess of periodic revenue over the associated costs. Revenue recognized on the sale basis is measured by the cash or its equivalent in physical assets secured by the enterprise at the time of transfer of the end product of operations to the customer. Though recognition of revenue will ordinarily be on the sale basis, the substitution of the production or cash basis may, under special circumstances, be justified.

Measurement of current costs will normally call for the determination by the accountant, at the time of sale, of the current price on those markets normally known and available to the enterprise of an amount of specific goods and services equivalent to those embodied in or associated with the product sold. It should be noted here that the term, equivalent, includes those goods and services available on the market at the time of sale,

which, though not physically identical to the goods and services embodied in or associated with the product sold, are their productive equivalents. It is by means of this latter approach to the measurement of current costs that allowance is made for technological improvement in the factors of production.

In the case of the labor element, this consideration of the productive equivalent will not arise too often but in the case of materials and especially the machines of production, it may be the principal consideration. If, for example, there should exist on the market at the time of sale a new material that is an effective substitute for the present material employed by the enterprise and the management indicates that in the future this new material will be substituted for the material now in use because of its lower current price, then this new material is in effect the productive equivalent of the material now employed. In measuring the current cost of the material now embodied in or associated with the product sold, the accountant should, under such circumstances, utilize the current price of an equivalent amount of the new material.

Likewise, if a machine now possessed by the company has been supplanted on the market by a new and more efficient machine which renders units of service identical to those now rendered by the present machine, then the current costs of the productive equivalent of the services of the present machine are the current costs of depreciation on the available new machine. It will often be necessary for the accountant to adjust the current costs of depreciation, as computed on the basis of the new machine, in order to reflect the ability of the enterprise, because of capacity considerations, to normally utilize only a certain proportion of its productive output.

The failure on the part of accountants to consider the possibility of the existence of productive equivalents and to continue the measurement of current costs on the basis of the current market price of the physically identical goods and services available on the market at the time of sale, may result in the overstatement of current costs and the understatement of enterprise income. This will be the case in those instances where management has ascertained that technological improvements have resulted in making available on the market at the time of sale, equivalent productive factors having a lower current price or a higher efficiency, sufficient to offset a higher current price. To make the assumption

that the level of technology is static admittedly simplifies the process of measuring current costs but the ignoring of reality on the part of those who would develop this approach, leaves it open to criticism similar to that levelled at present accepted accounting standards, i.e. unrealistic income determinations. The fact is that the seriousness of the error in income determination here, rather than being magnified in periods of both rapid price fluctuations and technological change as is the case with present accepted accounting standards, would be confined solely to periods of the latter type.

Toward True Measurement of Income

The failure today of present accepted accounting standards to provide a useful measure of periodic enterprise income is occasioned by a fallacious assumption underlying these standards. The presumption that a dollar of measure possesses a constant value constitutes the primary reason why accounting has never fulfilled, to the highest attainable degree, its basic purpose. If accounting is to continue as the principal method of measurement of the results of periodic enterprise activity, a new approach to the problem of cost measurement must be instituted. This approach must provide a measure of the enterprise income that is in keeping with the needs of the investor, management, and the general public. What these associated groups need is a measure of the degree of attainment of their aims.

The aim of the investor is embodied in the stream of anticipated future personal income expected from his investment. He envisions such income in terms of dollars of general purchasing power equal to those he invests. Once the savings of the investor have been transferred to the control of management, however, they become funds possessing specific purchasing power measured in terms of the current prices of the productive goods and services needed to carry on the planned operations of the business. This is because the investor group has based its anticipation of future income upon the presumption that it will be secured by future production and distribution of the planned specific end product of the operations of the enterprise. The maintenance of this specific purchasing power of the enterprise is of paramount importance to the investor group, for it is only through such maintenance that planned future operations can be conducted and anticipated future income secured. To the investor, periodic in-

come of the enterprise can be measured in current dollars, only after a portion of the cash or its equivalent, equal in specific purchasing power to the funds originally invested in the productive goods and services embodied in or associated with the end product sold, or their current productive equivalents, has been segregated from the total of cash or its equivalent provided by the revenue stream. The aggregate of dollars of such specific purchasing power, a measure of the cost to be associated with revenue, can best be determined at the time of sale by reference to the current prices, i.e. current costs, on the market of similar goods or services or their productive equivalents.

It is management's responsibility to carry out the planned operations of the enterprise, and it is accountable to the stockholder group on the above basis for the discharge of this responsibility. The emphasis upon measuring income, as the excess of revenue over current costs, is in keeping with the aims of the general public, for the public is, or should be, primarily interested in the maintenance of specific purchasing power by the economy as a whole, as it is a direct measure of the maintenance of physical capital which makes possible the retention of the present standard of living. Thus, the measure of enterprise income that meets the needs of these groups can only be provided by the matching of revenue with current costs. Other methods such as stabilized accounting will not provide the required measure.

Accountants at present, it would seem, face a choice. They can continue to adhere to present accepted standards making no endeavor to remedy their shortcomings, thereby continuing indefinitely accounting's present major contribution to the confusion surrounding all attempts to measure the results of business activity, or they can begin a concerted effort to develop procedures that will enable them to measure current costs for the purpose of realistic income determination. The expression of fears that objective procedures accomplishing such an end will never be developed have no validity here. The fact is that we must try, by every means humanly possible, to develop such procedure. It is high time that accountants in general substitute for their present doubts and fears on this matter a new attitude which recognizes that methods to attain objectives essential to the well-being of society seldom if ever fail to appear when the search for them is truly diligent.

PRODUCTION AND INVENTORY CONTROL IN A STEEL ROLLING MILL

by MILTON B. FROHN,

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Production control underlies operating economy and customer service and is one of the principal props of inventory control and accurate costing. The present article sets forth a closely knit production control system which keeps tabs on individual "lifts" of steel from operation to operation and renders production performance in each department readily available through daily reports.

PRODUCTION and inventory control has always been essential to a sound, profitable business, but today in an inflationary period it is especially needed because of its usefulness in maintaining a minimum inventory investment consistent with good operating practice. By "production and inventory control" is meant any system or device designed to insure the flow of materials (raw, semi-finished, and finished) through the plant in the most economical way feasible. The problem is a dual one in that it is essential to and requires the active participation of both the operating and the accounting departments. It is essential to the operating department for its importance in solving the problems of warehousing space, machine loading, ordering, shipping, product identification, etc. The accounting department finds it useful for production recording and verification, bonus computation, physical inventory taking, etc.

Complexities Arise Where Product Identification Is Difficult

Once it is determined that a system of production and inventory control is desirable (and in almost all cases it would be), the problem becomes one of establishing a system that will contain the desired benefits without entailing undue complication. Of course, purely from an accounting standpoint, it would be highly desirable to produce an entire customer's order without delay between processes and without division of production between like machines. However, in most cases it is not practicable to do this from a production standpoint. The system must be tailored to production practices and requirements. The accounting benefits often

appear as by-products. In situations that do not involve complex problems of product identification the task of devising a workable system may not be so difficult. However, where a wide variety of products outwardly similar in physical and chemical characteristics is produced, the problem becomes much more complex.

Specifically, our case here concerns a mill producing flat rolled steel products. It receives its principal raw material from a sister mill, which it first hot rolls into sheets—a saleable product in themselves. However, these may in turn be cold rolled, and annealed, and/or galvanized, and corrugated. At each step in the processing chain a new product appears which may be an end product or may be used as raw material for further processing.

Products are produced to customer order and specification. The specifications (of which there are hundreds) details the kind of steel, the treatments necessary, and the tolerances for size, flatness, and coating. The specification is the basis for product costing and inventory control. Shipment of finished product normally occurs immediately after its production and the stocking of raw materials is determined largely on the basis of immediate production schedules.

Control Problem Centers on Work in Process

Under these circumstances, although the control of both raw and finished material inventories is important and requires attention, it is the work-in-process inventory which demands dynamic control. Prior to reaching the finishing operations the products are processed on one of four primary producing units, each with a different cost. Many of the finished products can be produced on either of two (or sometimes more) of these primary units as their size and gauge ranges overlap. Product is conveyed through the plant by overhead cranes and individual pieces of one order are stacked into packages known as "lifts." Since the products are similar in appearance but are unlike in physical and chemical properties, it is essential to identify accurately each "lift" through each operation from the primary producing unit until it is shipped. In fact, the industry selected for this case study was chosen because of the complexities encountered in providing positive identification of products which look alike, but are entirely different because of physical and metallurgical specifications and finishing treatments.

The system described herein, the principles of which are applicable to all industries, was designed to control inventories, produce one set of figures to serve accounting requirements, and also provide the information necessary for effective production planning and control. In designing this system, there were two objectives:

1. To provide a practical and economical method for obtaining the basic information.
2. To summarize the information quickly so that it would be readily available to those responsible for planning operations and for controlling production.

Initiating Production Control: The Rolling Schedule

The initial step in the production planning process is the preparation of the rolling schedule. Since the product is specialized and produced to customer orders, the rolling schedule of production is based on the shipping schedule prepared by the sales department. The rolling schedule, an example of which is shown as Exhibit 1, serves as a work order for all processing and shipping operations involved and provides all essential information such as order number, customer name, number of pieces, size, gauge, tolerances, promised date, etc. Although the rolling schedule may deal with several products, only one is illustrated in Exhibit 1, so that the production control principles applicable to subsequent phases of manufacture may be more easily followed.

ROLLING SCHEDULE

ROLLS: 38" FOR WEEK OF January 2 194 8 SCHEDULE No. 109

PRODUCT CODE	MULTIPLIER SHEET WEIGHT	SPECIFICATION AND TREATMENT
7 7 1 2 2 1 1 5 1 4 0 0 1 0 0	26.02	Hot Roll—Cold Roll—Anneal—Galvanize—Corrugate 16078

ORDER No.	CUSTOMER	No. SHEETS	WEIGHT SHEET	WEIGHT TOTAL	GAUGE AND SIZE	TOLERANCE PLUS WIDTH	TOLERANCE PLUS LENGTH
93045	Black Co.	1344	24.75	33264	.110—30" X 108"	1/8"	1/8"
					24 sheets		

-CUT COILS-

No. PIECES	FT. WEIGHT	WIDTH & LENGTH	THEO. WT.	PROMISED
708	343—1	33½" X 75½"	24.46	1/19/48

AUTHORIZED CUT-DOWNS	ORDER No.	CUSTOMER	GAUGE AND SIZE	SPECIFICATION AND TREATMENT	TOLERANCE PLUS WIDTH	TOLERANCE PLUS LENGTH
	93049	White Co.	.110—33" X 96"	(Same as above)	1/8"	1/8"
SPECIAL INSTRUCTIONS						

EXHIBIT 1

PROGRESS RECORD

TREATMENT	DATE	EQUIP. NO.	SCRAPPED SHEETS	SCRAPPED WEIGHT	REJECTED SHEETS	REJECTED WEIGHT	FINISHED SHEETS	FINISHED WEIGHT	INITIALS OF FOREMAN	REMARKS
C.R.	1/6	8			2	48	494	11852	DR	
BXA	1/10	24	1	24			493	11828	C.V.	

Nº D 1099

OPERATION PROGRESS REPORT

EQUIP. NO.	DATE	TURN	SCHEDULE NO.	ROLLER
5	1-5	1	100	Del

ANNEALING BOTTOM NO.	HEAT NO.	CUSTOMER	DATE PROMISED
	871341	Black Co.	1/19/48

NO. SHEETS	GAUGE	SIZE	ACTUAL WEIGHT
496	110	30 X 108	11900

THEO. SHEET WEIGHT	TOTAL THEO. SHEET WEIGHT	AVG. ACTUAL SHEET WEIGHT
24.75	33264	23.99

GRADE OF STEEL	MADE FROM	INSPECTED BY
771-2211-314-00100	TMC-2	

TREATMENT SPECIFIED
HR—CR—ANNEAL—GALV—CORR 1607A

	SHEETS	ACTUAL WEIGHT	CODE
FINISHED	494	11852	
SCRAPPED			
REJECTED	2	48	
CONSUMPTION	496	11900	

REASON FOR SCRAPPING: Bent Corner

DATE	TURN	EQUIP. NO.	OPERATION
1-6	7-3	5	Cold Roll.

REMARKS:

Nº D 1099

OPERATION PROGRESS REPORT

EQUIP. NO.	DATE	TURN	SCHEDULE NO.	ROLLER
5	1-5	1	100	Del

ANNEALING BOTTOM NO.	HEAT NO.	CUSTOMER	DATE PROMISED
	871341	Black Co.	1/19/48

NO. SHEETS	GAUGE	SIZE	ACTUAL WEIGHT
496	110	30 X 108	11900

THEO. SHEET WEIGHT	TOTAL THEO. SHEET WEIGHT	AVG. ACTUAL SHEET WEIGHT
24.75	33264	23.99

GRADE OF STEEL	MADE FROM	INSPECTED BY
771-2211-314-00100	TMC-2	

TREATMENT SPECIFIED
HR—CR—ANNEAL—GALV—CORR 1607A

	SHEETS	ACTUAL WEIGHT	CODE
FINISHED	493	11828	
SCRAPPED	1	24	
REJECTED			
CONSUMPTION	494	11852	

REASON FOR SCRAPPING: Metallurgical Reject
REASON FOR REJECTING:

DATE	TURN	EQUIP. NO.	OPERATION
1-10	3-11	24	Bx Annealing

REMARKS:

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The schedule is prepared by the operating department and copies are sent to the accounting department and *to each processing point through which the product must pass on its way through the mill.* In the selected example in Exhibit 1 these would be:

1. *Coil shears,* where raw material is cut to size necessary for processing into finished product.
2. *Hot rolling mills,* where raw material is rolled to thickness and sheared to size.
3. *Cold rolling,* where the sheets are flattened and smoothed.
4. *Annealing,* where sheets are heat-treated to desired softness.
5. *Galvanizing,* where zinc coating is applied to produce galvanized sheets.
6. *Corrugating,* where the galvanized sheets are corrugated.

It will be observed in the section of the schedule captioned "Cut Coils" that 708 pieces are to be cut, as each piece will produce two sheets. This provides for a total of 1,416 finished sheets, whereas only 1,344 pieces are covered by the order for finished product. This excess is to insure full delivery after scrapping or cutting down to smaller size any sheets which may be rejected or damaged during processing.

Operation Progress Reports

As maintenance of the identity of the material through the various processes is of prime importance and as establishment and maintenance of current process data is also closely tied in with production progress and control, it will be well at this point to describe the identification system which is the keystone around which production and inventory controls are built. This system culminates in a Progress Record (Exhibit 2) which is the reverse side of a material identification card having one or more paper flaps attached, two of which are also illustrated in Exhibit 2. The flaps are (and are imprinted as) operation progress reports from which data is posted to the progress record. It must be borne in mind that in actual use the flaps rest one above the other.

The forms illustrated by Exhibit 2 are also called product assembly cards and are printed in several series, all identical except for the "Treatment Specified" section, and prenumbered in each series to identify each "lift" of steel—each flap of a set bearing the same serial number. The number of paper flaps attached to sets of each series is governed by the number of process points

necessary to meet the specification of processes through which the material must pass. The cards and flaps comprising each assembly are printed in various colors to designate the several initial processing points. For example, if the initial process is hot rolling, an assembly of the color denoting hot rolling is prepared with sufficient flaps for use in reporting progress by each processing center according to the treatment specified in the rolling schedule.

To expedite preparation of these progress reports in the shop and to minimize errors, the central accounting office types all pertinent information that appears on the rolling schedule. As the form assembly is provided with "snap out" carbons, this information appears on all flaps and on the identification card. The form assemblies are then sent to the indicated initial processing centers.

At the initial processing center, the weighman files the form assemblies by rolling schedule number and, as the material is processed, he completes the flap showing production information for initial process down to section "Consumption," detaches it, and places the remainder of the form assembly with the material that is to be further processed. As the material passes through each subsequent process, the paper flap for that process is completed by the weighman as to the results of that process and detached. However, proper notation is also made on the progress record, which accompanies the "lift" the whole way, by carrying up information from the flaps.

After record is made as to each process, the flap for the process detached, and the remainder of the assembly secured to the material to accompany it to the next scheduled operation, the retained flap is used as the basis for posting the production report of the process center as well as a posting medium for an inventory control record (later described under production recording). This same procedure is followed until the material passes through all scheduled operations and is ready for shipment to customer. The material identification card remaining with the material thus shows, at all times, the treatment history of the material as well as the scheduled treatments remaining. This serves to identify completely the particular item of inventory to which it is attached.

Production Reports

At each process production is recorded, usually after the product has been weighed. Such recording not only establishes the pro-

COLD ROLLING
TIME AND PRODUCTION REPORT

DATE 1-6 TURN 7-3 MILL NO. 8

LIFT NO.	SCHEDULE NUMBER	NUMBER SHEETS	GAUGE	SIZE	WEIGHT: FIRST COLD ROLL PASS BEFORE ANNEALING	WEIGHT: FIRST COLD ROLL PASS AFTER ANNEALING	WEIGHT: SECOND PASS	WEIGHT: THIRD PASS
C767	100	496	110/24	30 X 108	11900			
				X				
				X				
				X				
				X				
				X				
				TOTAL				

TIME REPORT

OCCUPATION	BADGE NO.	NAME	HOURS
ROLLER	1368	Brown	8
CATCHER	1292	Jones	8

DELAY TIME

START	STOP	REASON
11:00	11:25	Polishing Rolls

EARNINGS

GROUPS	30 GAUGE AND HEAVIER		CAN STOCK		29 GAUGE AND LIGHTER		TOTAL
WEIGHT							
OCCUPATION	RATE	AMOUNT	RATE	AMOUNT	RATE	AMOUNT	TOTAL
ROLLER							
CATCHER							

RECAP. FOR EARNINGS SIGNED: TOTAL EARNINGS

CODE	WEIGHT	CODE	WEIGHT	CODE	WEIGHT	CODE	WEIGHT

FOREMAN Lee

TURNED IN _____ CHECKED BY _____

EXHIBIT 3

duction of the process department but, as the names and badge numbers of the employees who did the work are shown, the Time and Production Report (Exhibit 3) also provides the means for computing the payment of wages where the employees' earnings are on an incentive or piecework basis. Delay time is also shown for use in judging production efficiency. While each of the processing departments are slightly different from others, they are basically the same. For that reason, Exhibit 3 serves to illustrate the report used for recording production in the plant as a whole.

After production is recorded in the process department, there remains the job of accumulating the production data by rolling scheduled number and by each process. This function is performed in the plant general office through use of a Production in Progress and Inventory Control shown as Exhibit 4. One sheet is prepared in blank for each schedule number and the related rolling schedule is reproduced by hektograph process in the lower right-hand corner of the report. The reports are then filed in a ring binder in schedule number order. They are posted from the

PRODUCTION IN PROCESS AND INVENTORY CONTROL

TREATMENT SEQUENCE

PERPETUAL INVENTORY

ROLLING SCHEDULE FOR WEEK OF January 24, 1948

SCHEDULE NO. 107

PRODUCT CODE: 7 7 1 2 2 1 1 4 0 1 0 0

ROLLS: 30"

SPECIFICATION AND TREATMENT: Hot Roll—Cold Roll—Anneal—Galvanize—Corrugate 1607-4

ORDER NO.	CUSTOMER	No. SHEETS	WEIGHT TONS	GAUGE AND SIZE	ANNEALING PACKING
					GOOD BAD
90065	Black Co.	1344	24.75	.110—30" X 108"	1/8" 1/8"
			33344		1/8"

CUT BARS—CUT COILS—SLABS

No. PIECES	FT. WEIGHT	WIDTH & LENGTH	THEO. WT.	PROMISED
706	343—L	32½" x 72½"	54.46	2/29/48

AUTHORIZED CUT-DOWNS	ORDER NO.	CUSTOMER	GAUGE AND SIZE	SPECIFICATION AND TREATMENT	DISPOSITION PACKING GOOD BAD
	90960	White Co.	.110—30" x 96"	.110—30" x 108"	1/8" 1/8"
SPECIAL INSTRUCTIONS					1/8" 1/8"

EXHIBIT 4

paper flaps (detached in the process departments as described earlier) which are received in the general office attached to the department's time and production report for the day. Thus the production shown on the progress and inventory control completes the circle and furnishes full control as to: (1) scheduled production, (2) production in progress, and (3) finished products.

As process information is posted each day, this control report serves many useful purposes, the most important being:

1. Shows status of treatments or processes on an entire rolling schedule number.
2. Assists in expediting material through the processes to the finished state.
3. Furnishes perpetual inventory record, by processes, of all in process and finished material.
4. Furnishes information as to excess production, permitting immediate application to other orders.

Until the time of shipment and until disposition is made of excess production, if any, the inventory control pages for each rolling schedule number are filed in a binder with appropriate indexes as to kind of product, size, etc., making the information readily available for operating and accounting reference of any sort.

Production by processes presents only a recapping problem. All pertinent information on paper flaps for a given process (such as weight of good product, scrap, etc.), is tabulated by necessary major and secondary product groupings and the grand total for a period verified by comparison with the total of the time and production reports of the same process for the same period.

Basic Data for Cost Reporting

It will be observed that the use of the flaps (Exhibit 1) for each processing department permits flexibility as to compilation of reports from primary source data. As previously mentioned, production reports are prepared for all production and are accompanied by operation progress reports as supporting data. This data is audited and posted by individual items to the inventory control record. All basic data has now been developed and recorded, and the final application thereof consists of its utilization as a medium for compiling units of production by desired classifications for budget computation purposes. The unit ticket method is especially advantageous in this respect inasmuch as it eliminates the necessity for manual tabulation. It is discussed

briefly at this point to illustrate its application and utilization through the entire accounting process.

The flaps are sorted daily by budget factors such as type of material, gauge, size, etc. Differentiated standard rates are applied to each classification and the aggregate constitutes the current performance budget for the day. These figures, with corresponding actual costs, are furnished in a daily report to various interested levels of plant management. The figures are also carried forward daily, thereby showing the variance position at any time during the month. The total for the month at the differentiated standard rate mentioned, thus accumulated and compared with actual cost, permits determination of the current performance budget for the month.

Accounting Control of Inventories

Accounting control of production and inventories is based on information recorded on the procedural basis of this system, i.e., the material identification card. When we last mentioned this card, it was traveling with the material from operation to operation bearing production data transcribed from the flaps before they were detached. For material on hand at time of physical inventories, these cards not only show weights but provide definite determination as to value of the product in whatever stage found, as the record shows material used in producing, treatments received, etc.

Proper inventory account classification is maintained for significant product groupings. Inventory values are computed in accordance with above described principles and processed through the applicable inventory accounts. Values for production-in-process inventories increase progressively at each stage of processing, until completed. Inventory dollar balances therefore represent the aggregate of standard product costs, whether finished or in process. Therefore, it will be seen that the basis of the system is the standard specification cost.

Because of the diversity of treatment specifications, gauges and sizes, etc., it is essential for control purposes that perpetual inventories of work in process and finished products be maintained. There are two features of control to be considered, namely, (1) control over production recording and progress of operations, and (2) accounting control over perpetual inventories. Control over production recording and progress of operations, as

has been indicated during the course of the paper, is maintained by use of the production in progress and inventory control system. Exhibit 4 shows an example of a typical order, with postings by lifts through the various processes, namely: hot roll, cold roll, box anneal, galvanize, and corrugate. Shipments are posted, and balance, if any, brought forward. Accounting control over perpetual inventories consists of maintaining principal control accounts by work-in-process and finished products, which are grouped according to a broad product classification, such as hot rolled sheets, galvanized sheets, galvanized formed sheets, etc. Subcontrols are also maintained by treatment specification, which in turn are classified as to material used, method of rolling, treatments received, and gauge and size grouping.

Transfers of Excess Production: Recording Rejects

Because of the rigid inspection necessary to maintain a high quality product, numerous pieces are scrapped or rejected during the various production processes. For that reason it is sometimes necessary to schedule production in excess of actual order requirements. Therefore, in cases where quality product is produced with less than anticipated rejections, over-production will result. All new orders are checked against records of excess stock before scheduling for production. Excess that may be applied to a current order is earmarked for that particular order. Excess stock applied to new orders is transferred to the new schedule number by inventory clerks upon receipt of information furnished by the production department.

Even in the case of rejected material a careful record must be maintained. A perpetual inventory of rejects proves of invaluable aid for use in filling and scheduling orders for secondary product, and is also necessary for complete accounting control of inventory.

Implementing Operating and Accounting Objectives

In presenting this case study, the examples given have been kept to the simplest form to illustrate the system. However, in actual practice, the processing information becomes complex due to the multitude of product classes and sizes. The system, by reason of its flexibility, has been found to meet the needs of almost any situation. It is not, however, one requiring only the effort of the accounting department. To obtain successful operation requires the assistance and enthusiastic cooperation of the operating department, especially in seeing that the identification

cards remain with the material at all times. This assistance of the operating department is not difficult to obtain as the information furnished by strict adherence to the plan is the kind of information needed in planning and scheduling processes and shipments.

The close relationship between accounting control of inventories and production planning and scheduling requires close coordination to maintain satisfactory control of the two functions. Otherwise, costly duplicated effort and inefficiency would result. Basic records such as schedules, production reports, identification tickets, shipping documents, etc., originating at various control centers, are designed to cover all underlying data common to both functions and to permit an orderly summarization and analysis thereof to the extent of the separate requirements.

COMING ARTICLES

In the *N. A. C. A. Bulletin*, June 1, 1949

Retail Inventory Method Adapted to Appliance Merchandising in a Public Utility

by Frank D. McAuley

Use of the Retail Inventory Method to Cost Sales and Value Finished Goods of a Pharmaceutical Manufacturer

by Raymond J. Terkhorn

Costing Replacement Parts Sales by Modified Retail Inventory Method

by Warner V. Stoughton

CONTINUOUS REVIEW OF FORMS, METHODS, AND PROCEDURES

by LAWRENCE P. JENNINGS,
Member of Office Methods and Procedures Staff,
Caterpillar Tractor Co., Peoria, Ill.

The approach afforded by this article to the several important phases of the betterment of office routines in an industrial company stresses cooperation from proposal to acceptance. Large scale innovation is avoided under the procedure outlined but provision is made for broad coverage and continuous review of routines in force and the forms and methods which implement them.

ACCOUNTANTS and the accounting profession have an interest in the reduction of office costs through the use of improved methods. This article, intended to further stimulate such interest, describes the establishment and operation of a methods group staffed by personnel previously employed in the company as accountants or auditors and set up as a part of the accounting department.

Creation of Office Methods and Procedures Division

Caterpillar Tractor Co.'s Office Methods and Procedures Division was created to fill a long-felt need and oft-expressed desire for a group of trained employees who would be available to department heads for analysis and review of office methods and procedures followed in their departments, with a view to suggesting improvements leading to more economical operation. It was considered desirable that the division be a part of the accounting department because that department, in itself a major office function, is also directly or indirectly involved in most of the clerical operations performed throughout the company. Every member of the original staff was recruited from the internal auditing division where the work, of necessity, required an especially intimate knowledge of the functions of other departments.

The position of the new division within the organizational structure is the same as any other division in the company. The division manager reports to the general auditor and has only advisory authority. This offered assurance at the outset that the division would *suggest* changes rather than *order* them. The work of the

division is carried on by three specialized sections: (1) the forms control section, (2) the methods section, and (3) the procedures section. The work of each section will be taken up.

Forms Control Section

The primary function of the forms control section is to subject all of the office forms used by the company to a constant review and analysis to determine that, as tools in the hands of clerical workers, they are efficient and accomplish necessary work. When analysis indicates that a form is not efficient, it becomes the task of the forms control section to redesign the form so that it will be. Similarly, should a form appear to be accomplishing unnecessary work, the forms control section is expected to take steps to eliminate the form from supply.

In order to carry out its primary function, the forms control section has access to every form used by the company. This was accomplished when the division first became operational by requesting every department within the company to send to the forms control section three copies of every form used. These copies were then used to establish three separate files as follows:

1. Numerical file by form number.
2. Alphabetical file by the department using the form.
3. Functional file by the function performed by the form.

The forms thus filed were not intended to be subjected to analysis in themselves but were gathered merely to implement the method by which such analysis was to take place on the proper occasions for it. The next step was to require that the forms control section review all requisitions for the printing of forms before the requisitions could be filled. Since a copy of the form must accompany the requisition, the section is not only able to take up each form on an individual basis but to prevent the possibility of new forms being designed and stocked without the knowledge of the section. This particular approach to analysis of forms, i.e., as they are requisitioned, has two distinct advantages. First, it is simple. It is entirely self-regulating to the point where in the course of one year the section has been able to take up for analysis every form used in the company. The second advantage is one of timing and costs. Analysis of a form at a time when the supply is at a minimum means that—should it become obsolete through redesign, replacement, or elimination—there will be a minimum on hand to scrap.

The manner in which the forms control section functions is understandingly simple since simplification is the basis for its existence. As requisitions are delivered to the section, they are placed in the hands of a forms analyst whose duty it is to carefully scruitinize the form to determine the following:

1. *Is the form properly designed?* This is a broad question covering a variety of things and has been the subject of complete articles and even books. No attempt to outline form design principles will be made here. The forms analyst is aided in this phase of his work by various reference publications and through frequent contact with manufacturer's representatives.

2. *Is the information entered on the completed form available on some other form or report?* This is a particularly important question since duplication of effort adds nothing but cost to the operation of the company. The answer may be found in either the functional or the departmental files mentioned earlier. By comparing the form being analyzed with other forms performing a similar function, it is often possible to eliminate one or the other. This not only reduces costs by the cost of the form and of the labor involved in its completion, but may also increase the value of other forms by extending their usage over greater areas.

3. *Can this form be combined with other forms?* Here again reference is made to the functional and departmental files. Combined forms result in reduced form costs.

As these items are taken under consideration by the forms analyst, he also makes certain routine checks of both the form and the requisition. For one thing, he compares the quantity being requisitioned with the past usage as shown on the requisition. Should the form be a new form or a revised form, he makes a record of it so that, when printing has been completed, copies may be secured for inclusion in the section's files. After the form and the requisition have passed the scrutiny of the forms analyst, they are delivered to the section supervisor for his approval. Here again the form is subjected to at least some further analysis before being released for procurement.

Methods Section

The primary function of the methods section is to review and analyze the office routines of the company to determine that they are necessary and are being performed as efficiently as possible. One of the first problems faced by any newly-formed methods staff is to determine which office routines require attention, out of the hundreds performed within the company, and solution to this problem is an important step in the progress of the organization.

As soon as Caterpillar Tractor Co. announced that an office methods and procedures division had been established, a few department heads addressed letters to the division manager outlining specific problems which they felt merited investigation. These letters were assigned numbers to simplify filing until such time as a methods analyst might become available to undertake study of the situation. By the time the methods staff had been assembled, a small backlog of these "project letters" had been built up. Today the number of project letters which have crossed the desks of the section number into the hundreds and provide the basis for every investigation conducted by members of the staff.

Project letters originate at the following major sources:

1. *Other departments.* Most project letters originate outside of the division in other departments of the company. Department heads welcome assistance in the working out of knotty problems in both methods and procedures so that departmental expenses may be reduced. Because department heads may accept or reject any solution offered by the methods staff, there is no reluctance to ask for assistance.
2. *Internal auditing division.* Many project letters originate at the request of the internal auditing division of the accounting department. During the course of an audit review —when it becomes apparent that present practices are uneconomical or lacking proper internal check features—the internal auditing division informs the office methods and procedures division. The two divisions then cooperate in the development of a new or revised system.
3. *Forms control section.* In many instances, the work of the forms control section necessitates changes in methods. When this situation occurs, the forms control section initiates a project letter and works closely with the methods section in developing the solution.

4. *Methods section.* Many projects originate within the minds of the methods analysts themselves. As investigations are conducted on various projects, these men are constantly on the alert for poor or improper methods. When such methods are observed, the methods analyst making the observation initiates a project letter.

All project letters are subjected to a preliminary analysis by the division manager so that those letters requiring prompt attention can be given early processing. This preliminary analysis often results in an immediate solution since the answer may become at once apparent to the division manager. This latter possibility is further explored by *routing all new project letters to every member of the staff* before these letters are placed in the project file to be taken up in proper sequence.

As methods projects are undertaken and solutions devised, the methods analysts attempt to embody in these a better way of performing office work and thus to provide an affirmative answer to some or all of the following questions:

1. Is the proposed method quicker than the method being superseded?
2. Is the proposed method more accurate?
3. Is the proposed method sound in its internal check aspects?
4. Is the proposed method cheaper?

When a practical solution or suggestion has been found, the details are given to operating heads in the form of a "proposal letter." Proposal letters also request that comments and suggestions be made regarding the solution. When such proposal letters are returned to the methods analyst, it is his responsibility to reconcile all differences. When complete accord has been reached, the project is closed by the issuance of either a memorandum or a completely new procedure (approved by the department head or heads affected), depending upon the degree of change necessary to put the new method into effect.

Procedures Section

Since procedure writing is something of an art, this phase of the work has been delegated to a separate section, the procedures section. The function of this section is not only to write new procedures born of new methods but also to reduce to writing many well-established procedures which heretofore have not

received such treatment. Although not all-inclusive, the following list shows some of the uses to which such procedures have been put to increase efficiency and reduce costs.

1. Instructing new employees.
2. Guiding employees and supervisors alike in the performance of infrequent, complex systems.
3. Settling questions of jurisdiction.
4. Reducing company operating rules to writing for the benefit of auditors, both public and internal.

Conclusion

In reviewing the organization and function of the office methods and proceures division, it is felt that certain points warrant restatement since they represent workable solutions to problems facing any organization contemplating the installation of a methods staff as part of a cost reduction program. These points are:

1. The division is part of the accounting department, the department most closely related to all office functions.
2. The division is staffed by accountants, a group already familiar with most office routines.
3. The division functions entirely as a service organization rather than a group with superdepartmental authority.

How well the division has fulfilled its primary function may be measured by the following accomplishments:

1. Of the more than 3,000 printed forms reviewed during the first nine months of operation, 482 forms were eliminated and 104 forms were created, resulting in a net reduction of 378 forms. In addition to the direct cost reduction resulting from the elimination of these forms, a much larger cost reduction was realized through the elimination of routines which were required to complete the forms.
2. Eighty-one projects were completed during this period, which resulted in the revision of fourteen major systems and the establishment of twelve new systems with measurable annual savings to the company of many thousands of dollars.

The office methods and procedures division is now one year old. During its first year of operation, it has proved to be a valuable force in our company-wide cost reduction program. In our opinion, that value will increase in the future.